CLAIMS

What is claimed is:

1. A method for forming an opening in a semiconductor device comprising:

forming an anti-reflective coating (ARC) layer above an insulation layer of a substrate;

forming a patterned photoresist layer including at least one opening therein above the ARC layer;

etching the ARC layer and the insulation layer in a process comprising:

introducing a first gas including fluorocarbon gas for etching and polymer formation;

introducing a second gas containing oxygen for polymer formation control; and

partial etching the ARC layer defined by the at least one opening and subsequently forming a polymer layer on the inside of the at least one opening.

2. The method of claim 1, further comprising:

repeating the step of partial etching and polymer formation to form the at least one opening in the ARC layer; and

continuing the step of partial etching and polymer formation to form the at least one opening in the insulation layer.

3. The method of claim 1, wherein the opening includes a contact.

4. The method of claim 1, further comprising forming an etch stop layer above the substrate prior to the step of forming the insulation layer.

5. The method of claim 4, further comprising:

removing the photoresist layer and the ARC layer; and

continuing the step of partial etching and polymer formation to form the at least one opening in the etch stop layer, such that a conductive layer is subsequently formed in the at least one opening in the insulation layer and the etch stop layer to electrically contact an active region of a transistor.

6. The method of claim 1, wherein the insulation layer includes an interlayer dielectric (ILD).

7. The method of claim 1, wherein the fluorocarbon gas comprises CxFy, where x ranges from 0 to 9 and y ranges from 0 to 9.

8. The method of claim 1, wherein the fluorocarbon gas comprises CxHyFz, where x ranges from 0 to 9, y ranges from 0 to 9, and z ranges from 0 to 9.

9. The method of claim 1, wherein the second gas is selected from the group consisting of O2, CO, CO2, NO, N2 and NO2.

10. The method of claim 1, further comprising:

introducing a third gas for diluent and ion density control selected from the group consisting of Ar, He, Kr, and Xe.

11. The method of claim 1, wherein the photoresist layer and the ARC layer are subsequently removed such that a conductive layer is subsequently formed in the at least one opening in the insulation layer to electrically contact an active region of a transistor.

12. The method of claim 1, wherein the opening includes a via.

13. The method of claim 1, wherein the insulation layer includes an intermetal dielectric (IMD).

14. The method of claim 1, wherein the photoresist layer and the ARC layer are subsequently removed such that a conductive layer is subsequently formed in the at least one opening in the insulation layer to electrically contact a metal layer formed above the substrate.

15. A method for forming an opening in a semiconductor device comprising:

forming a first anti-reflective coating (ARC) layer above an insulation layer of a substrate;

forming a first photoresist layer having a first patterned opening therein;

etching the first ARC layer and the insulation layer in a process comprising:

introducing a first gas including fluorocarbon gas for etching and polymer formation;

introducing a second gas containing oxygen for polymer formation control;

partial etching the first ARC layer defined by the first patterned opening and subsequently forming a polymer layer on the inside of the first patterned opening;

repeating the step of partial etching and polymer formation to form the first patterned opening in the first ARC layer;

continuing the step of partial etching and polymer formation to form the first patterned opening in the insulation layer;

removing the first photoresist layer and the first ARC layer;

forming a second ARC layer above the insulation layer;

forming a second photoresist layer having a second patterned opening therein;

etching the second ARC layer and the insulation layer in a process comprising:

introducing the first and second gas;

partial etching the second ARC layer defined by the second patterned opening and subsequently forming a polymer layer on the inside of the second patterned opening;

repeating the step of partial etching and polymer formation to form the second patterned opening in the second ARC layer; and

continuing the step of partial etching and polymer formation to form the second patterned opening in the insulation layer.

16. The method of claim 15, wherein the opening includes a dual damascene opening.

17. The method of claim 15, wherein the first patterned opening is a via.

18. The method of claim 15, wherein the second patterned opening is a trench.

19. The method of claim 15, further comprising forming an etch stop layer prior to the step of forming the insulation layer.

20. The method of claim 19, further comprising:

removing the first photoresist layer and the first ARC layer; and

continuing the step of partial etching and polymer formation to form the first patterned opening in the etch stop layer, such that a conductive layer is subsequently formed in the first and second patterned openings in the insulation layer to electrically contact a metal layer formed above the substrate.

21. The method of claim 15, wherein the insulation layer includes an intermetal dielectric (IMD).

22. The method of claim 15, wherein the fluorocarbon gas comprises CxFy, where x ranges from 0 to 9 and y ranges from 0 to 9.

23. The method of claim 15, wherein the fluorocarbon gas comprises CxHyFz, where x ranges from 0 to 9, y ranges from 0 to 9, and z ranges from 0 to 9.

24. The method of claim 15, wherein the second gas is selected from the group consisting of O2, CO, CO2, NO, N2 and NO2.

25. The method of claim 21, further comprising:

introducing a third gas for diluent and ion density control selected from the group consisting of Ar, He, Kr, and Xe.

26. The method of claim 15, wherein the second photoresist layer and the second ARC layer are subsequently removed such that a conductive layer is subsequently formed in the first and second patterned openings in the insulation layer to electrically contact a metal layer formed above the substrate.